



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/AU97/00543 (22) International Filing Date: 21 August 1997 (21.08.97) (30) Priority Data: PO 1806 22 August 1996 (22.08.96) AU (71)(72) Applicant and Inventor: KEMPIN, Ronald [AU/AU]; 3 Rodgers Place, Bull Creek, W.A. 6149 (AU).	(81) Designated States: AL, AU, BB, BG, BR, BY, CA, CN, CZ, EE, GE, HU, IL, IS, JP, KP, KR, LK, LR, LS, LT, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, RO, SG, SI, SK, TR, TT, UA, US, UZ, VN, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>	

(54) Title: PREVENTION OF MARINE ENCRUSTATION ON BRONZE PROPELLERS**(57) Abstract**

From the time that they are immersed into a marine environment, bronze propellers are prone to attack by marine organisms, such as barnacles, coral and algae, which attach themselves to the bronze metallic surface, creating lumps on the propeller, which adversely affect its balance and cause impedance and vibration of the propeller and its boat in the water. Ant-fouling paints are either too toxic for the marine environment or lack smoothness on the surface. These problems have been overcome by a combination of known steps, namely, polishing the propeller to prepare it for electroplating, cleansing to remove all traces of dirt and grease, electroplating with copper to a depth of at least 0.005" or 0.15 mm, followed by spraying with a standard solution (5 %) of sodium hypochlorite and sodium chloride in a suitable container to form a firmly adhering conversion coating of basic cupric chloride and then sealing for at least twenty-four hours. The preferred procedure for polishing is 60# grit size at 3500 sfm for roughing, followed by 180# grit size at 5500 sfm for finishing using grease as a polishing aid. Electroplating with copper to the minimum depth provides a smoothing effect ranging from 70 to 90 per cent. The container in which the hypochlorite spraying is carried out is preferably kept sealed until just before fitting and launching. A life expectancy of five (5) years can be anticipated with minimal maintenance every time the vessel is slipped.

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PREVENTION OF MARINE ENCRUSTATION ON BRONZE PROPELLERS.

This invention relates to a process for the prevention of marine encrustation on bronze propellers, which include tin bronze, aluminium bronze, silicon-aluminium bronze, nickel-aluminium bronze and manganese bronze propellers. As, in operation, water travels over the propeller blades at high velocity, it is essential for the efficiency of the propeller, that the surface be perfectly smooth, even and true. From the time that they are immersed into a marine environment, bronze propellers are prone to attack by marine organisms, such as barnacles, coral and algae, which attach themselves to the bronze metallic surface, creating lumps on the propeller, which adversely affect its balance and cause impedance and vibration of the propeller and its boat in the water. Various remedies have been tried including anti-fouling paints. One of these paints containing tributyl tin, was so toxic to other economic marine life, such as oysters, that it had to be discontinued. Its successor is so viscous, that its application to the finely polished surface of the bronze leaves brush marks in the form of grooves, which adversely affect the fine balance and vibration free performance of the propeller from day 1. Durability of the anti-fouling paint on the propeller can be as short as 30 days in active marine environments.

Accordingly, the inventive process seeks to provide protection from marine encrustation for an extended period of time. The process for the prevention of marine encrustation on bronze surfaces, in particular those of propellers, is characterised by the following steps:-

- (a) The cast propeller is first polished to the propeller production standard.
 - (b) The whole polished propeller is then cleansed, to remove all traces of dirt and grease.
 - (c) The cleansed propeller is then electroplated with copper to a depth of at least 0.005" or 0.15 mm.
 - (d) The electroplated propeller is then placed in a suitable container and sprayed with a standard solution of sodium hypochlorite.
 - (e) The container is then sealed for at least twenty-four hours and preferably kept sealed until just prior to launching.
- Thereafter, only minimum maintenance is required, when the vessel is slipped periodically, thus providing a substantial reduction in maintenance costs.

The first step in the preparation is polishing. Bronze propellers and associated structure are typically sand cast and require polishing to remove scale. Reference to this procedure may be found in the article ¹ " **Mechanical Finishing - Polishing and Buffing** ". The recommended procedure is 60# grit size at 3500 sfm for

roughing, followed by 180# grit size at 5500 sfm for finishing using grease as a polishing aid.

The second step in the procedure consists of surface preparation or cleansing to remove all traces of dirt and grease and may consist of one or more of alkaline cleaning
5 by dipping or electrolytic means, vapour degreasing and solvent cleaning in the article ² " **Metal Cleaning -**

Selection of Cleaning Process ". This surface preparation is also the subject of standard **ASTM B281 - " Preparation
10 of Copper and Copper Base Alloys for Electroplating.**" The third step involves electroplating the cleansed propeller with copper to a depth of at least 0.005" or 0.15 mm.

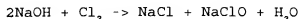
Various salts of copper may be used, but the most common are those of the two alkaline (cyanide and pyrophosphate)
15 baths and the two acid (sulphate and fluoborate) baths.

These are variously described in ³ " **Copper Plating** " by **Mattie F. McFadden** and are the subject of two standards **AMS 2418 and MIL-C-14550 (Ord)**. As well as providing an appropriate surface for subsequent processing,

20 electroplating with copper enhances the surface by providing a substantial levelling effect ranging from 70 to 90 per cent for a minimum deposition of 0.005" in thickness.

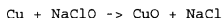
The fourth step in the process consists of placing the
25 electroplated propeller in a suitable container and spraying the electroplated surface with sodium hypochlorite solution. This solution is prepared by

chlorination of sodium hydroxide (caustic soda) solution

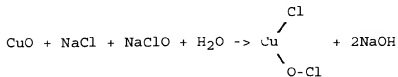


5 or, alternatively, by electrolysis of a sodium chloride (common salt) solution and reacting the product of the anode (chlorine) with the product of the cathode (sodium hydroxide). Sodium hypochlorite is routinely marketed as a 5% equimolecular solution of sodium chloride and sodium
10 hypochlorite for the disinfection and sterilisation of such places as dairies and milking sheds under various trade names such as Eau de Javelle, Chlorox and Dazzle. The reactions which take place with the copper surface are believed to be

15



(black)



20

(blue-green)

A first coating of black cupric oxide is formed, which coating is then converted to a blue-green basic cupric
25 chloride. The basic cupric chloride forms a firmly adherent coating, which resists the encroachment of marine organisms. A life expectancy of five years of effective protection against marine growth has been achieved,

5

providing ultimate thrust to manufacturers' standards,
together with precise balance and vibration-free
performance.

BIBLIOGRAPHY.

^{1,2,3}

Metals Handbook, 8th Edit., Vol.2-" Heat Treating,
Cleaning and Finishing." (ASM, Metals Park, Ohio 1964).

The claims defining the invention are as follow:-

1. A process for the prevention of marine encrustation on bronze surfaces, in particular those of propellers, to provide protection from marine activity for an extended period of time, characterised by the following steps:-
 - 5 (a) the cast propeller is first polished to the propeller production standard;
 - (b) the whole polished propeller is then cleansed, to
10 remove all traces of dirt and grease;
 - (c) the cleansed propeller is then electroplated with copper to a depth of at least 0.005" or 0.15 mm;
 - 15 (d) the electroplated propeller is then placed in a suitable container and sprayed with a standard solution of sodium hypochlorite;
 - (e) the container is then sealed for at least twenty-
20 four hours.
2. A process according to Claim 1, wherein the polishing procedure is 60# grit size at 3500 sfm for roughing,

followed by 180# grit size at 5500 sfm for finishing using grease as a polishing aid.


3. A process according to Claim 1, wherein the surface cleansing consists of one or more of alkaline cleaning by dipping or electrolytic means, vapour degreasing and solvent cleaning.
4. A process according to Claim 1, wherein the copper electroplating baths are alkaline.
5. A process according to Claim 4, wherein the copper electroplating bath is an alkaline cyanide bath.
6. A process according to Claim 4, wherein the copper electroplating bath is an alkaline pyrophosphate bath.
7. A process according to Claim 1, wherein the copper electroplating baths are acid.
8. A process according to Claim 7, wherein the copper electroplating bath is an acid sulphate bath.
9. A process according to Claim 7, wherein the copper electroplating bath is an acid fluoborate bath.

10. A process according to Claim 1, wherein the container is kept sealed until just prior to launching.

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/AU 97/00543

A. CLASSIFICATION OF SUBJECT MATTER		
Int Cl ⁶ : C23F 17/00, 15/00 B24B 1/00, C23C 22/63, C25D 3/38, 3/40, B63H 1/14, 1/28.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) IPC : C23F 17/00, 15/00, 7/02, B63H 1/14		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU : IPC as above, AU Cl. : 73.156.		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) (See attached sheet)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 188356 A2, (BARPRO LIMITED), 23 July 1986, (see page 3 line 3 to page 5 line 13 and Figure 1). -----	1-10
A	GB 823531 A, (SOCIÉTÉ DE CONDENSATION ET D'APPLICATIONS MÉCANIQUES), 11 November 1959, (see page 4 line 87 to page 6 line 82 and Figures 1 to 8 of the drawings). -----	1-10
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Date of the actual completion of the international search 7 November 1997.		Date of mailing of the international search report 27 NOV 1997
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929		Authorized officer  A. DAVIES Telephone No.: (02) 6283 2072

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C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages (Remove spaces when completed if the page is too long)	Relevant to claim No.
A	GB 1299126 A, (OYSTEIN RASMUSSEN), 6 December 1972, (see page 2 line 98 to page 3 line 47 and Figures 1 to 3 of the drawings). -----	1-10
A	GB 2026039 A1, (MOAT LIMITED), 30 January 1980, (see page 1 line 115 to page 3 line 38 and Figures 1 to 19 of the drawings). -----	1-10
A	PATENT ABSTRACTS OF JAPAN, UNEXAMINED APPLICATIONS, {CD No. 35, C25, 30, (1976-1993)}, JP 59/197590 A2, MITSUBISHI HEAVY INDUSTRIES LIMITED), 9 November 1984. -----	1-10
A	PATENT ABSTRACTS OF JAPAN, UNEXAMINED APPLICATIONS, {CD No. 19, B60-64 (1986-1989) (2/3)}, JP 61/012496 A2, (KAWASAKI HEAVY INDUSTRIES LTD. & TAKIRON CO. LTD.), 20 January 1986. -----	1-10
A	PATENT ABSTRACTS OF JAPAN, UNEXAMINED APPLICATIONS, {CD No. 108, Sep. 1994, (06/241601-06/276800)}, JP 96/270322 A2, (NIPPON STEEL CORPORATION), 27 September 1994. -----	1-10
A	US 3426473 A, (N.F. CARDARELLI, S.J. CAPRETTE JR.), 11 February 1969, (see page 2 line 52 to page 6 line 6 and Figures 1 to 3 of the drawings). -----	1-10
A	US 3458413, A, (K.UEDA, T.HORIGUCHI, M.HIRATA), 29 July 1969, (see page 2 line 63 to page 4 line 63 and Figures 1 to 3 of the drawings). -----	1-10
A	US 3497434 A, (E.L.LITTAUER), 24 February 1970, (see page 1 line 57 to page 3 line 17 and Figures 1 and 2 of the drawings). -----	1-10
A	US 5080926 A, (J.PORTER, L.SUHL), 14 January 1992, (see page 2 line 21 to page 3 line 42 and Figure 1). -----	1-10

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International Application No.
PCT/AU 97/00543

Continuation from Box B

Search on Electronic Data Base.

DERWENT WPAT.

SS1: B63H-001/IC OR B63B-059/04/IC OR C23/IC OR C25/IC (1768)

SS2: C23C/IC OR C23D/IC OR C23F/IC OR C23G/IC OR C25D/IC OR C25F/IC (147922)

SS3: 1 OR 2 (149619)

SS4: 3 AND BRONZE (556)

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SS3: 1 OR 2 (93114)

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(7 ABSTRACTS PRINTED)

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Information on patent family members

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Patent Document Cited in Search Report				Patent Family Member			
EP	188356 A2	AU US	52410/86 A1 4724107 A	JP	61/217250 A2	NO	860123 A
GB	823531 A	NOT	KNOWN				
GB	1299126 A	NOT	KNOWN				
GB	2026039 A1	AU NO	49154/79 A1 792426 A	DK WO	1066/80 A 80/00262 A1	EP	16080 A1
JP	59/197590 A2	NONE					
JP	61/012496 A2	NONE					
JP	06/270322 A2	NONE					
US	3426473 A	DE	1621935 A	ES	338679 A1	FR	1521867 A5
		GB	1185902 A	NL	6704657 A	SE	344313 B
US	3458413 A	DE	1642486 A	FR	1474268 A5	NL	6602891 A
US	3497434 A	DE	1771835 A	FR	1576662 A	GB	1176274 A
		JP	48/039343 A2	NL	6810165 A	SE	347924 B
US	5080926 A	NONE					
END OF ANNEX							